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Propagating Pecans

By Budding and Grafting

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PROPAGATING PECANS BY BUDDING AND GRAFTING.

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It is sometimes estimated that there are a hundred million wild pecan trees in Texas, and it certainly would be within bounds to say there are fifty million. Many of these trees stand too close together to admit of profitably top-working all of them, and some stand in unfavorable locations, where they would not produce paying crops even after being worked over. But, after making liberal deductions for such cases, there are still many millions left that should be budded or grafted .

There are thousands of farms crossed by streams and draws, the margins of which are skirted by pecan trees. Generally the banks of these channels are covered by dense growth of underbrush and briars, mixed with the trunks of dead trees and other debris. Such places serve no useful purposes, but do serve as homes for countless injurious insects. They should be cleaned up and kept clean, and the pecan trees growing there should be budded to fine varieties, thus converting the waste lands into the most profitable parts of the farms.

Native trees are shy and irregular bearers, as a rule, and produce inferior nuts; but there still occurs an occasional tree that bears a regular and heavy crop of nuts that grade high on all points of the scale. By the use of buds from such a tree any vigorous native one can be transformed.

Some idea of the economic importance of this work—to say nothing of its educational value—can be had by placing the number of trees suitable for budding at 10,000,000, and the average yield ten years after working at twenty-five pounds per tree. At 25c per pound such a crop would bring an income of $62,500,000.00. This estimate is conservative in all its items, particularly in that of time, as a tree three or four inches in diameter will produce a considerable crop four or five years after being budded, and even a budded sprout will produce a good crop in less than ten years.

The order in which the different methods of budding and grafting are discussed in these pages is not based upon their relative importance, but upon the time of year the work can be done. It is possible to chip-bud before the time for either bark-grafting or patch-budding, and the chip-budding is therefore placed before them.

Patch-budding is the most important method, and is recommended for general use. Particular uses for the other methods will be found under their proper headings.

Various methods of budding and grafting pecans are practiced, all with greater or less success, and it is not intended to assert that the methods hereinafter given are the only successful ones. But they cover every case that may arise, and it is thought best to deal with them only, in order to avoid confusing the beginner.

The various steps in these methods are not only indicated, but are to

some extent discussed and the reasons therefor given. This is done to call into play the judgment of the operator, without which the great task of budding and grafting the pecan trees of Texas can never be accomplished.

MANNER OF TREE GROWTH AND HEALING.

Before entering upon the discussion and illustration of the different methods of budding and grafting it is well to take into consideration the manner of growth of trees, as the processes involved in the operation of growth are the same as those involved in the union of scion with stock. Anyone handy with a knife can, after being shown the simple mechanical operation, bud and graft successfully if both scoins and stocks happen to be in proper condition at the particular time. But it requires a little knowledge of plant physiology, and considerable thought, to enable one to take advantage of all conditions in order to extend the working period from spring till fall. Morever, this knowledge and thought are of equal importance in connection with the treatment of buds and grafts after union has been effected Accordingly, only so much of plant physiology as is necessary to direct attention to the processes involved is here given—and it is urged that those undertaking to bud and graft pecans make constant mental reference to these statements, not only in connection with the acts of budding and grafting, but also in connection with the care of the buds and grafts after union.

Trees take certain food materials from the atmosphere through their leaves, and certain others, dissolved in water, through their roots. This water ascends through the longitudinal cells of the white sap wood.

These food materials, both those from the air and those from the soil, are acted upon in the leaves by sunlight, and are there transformed into elaborated plant foods, ready to be used by the tree in its growth. These prepared foods pass from the leaves through certain cells in the inner portion of the bark. This can be clearly demonstrated by wrapping tightly with string or wire a rapidly growing young sprout, and observing that it continues to grow above the wrapping, but not below, its supply of food from the leaves having been cut off. It is therefore plain that the leaves of trees are their food factories.

But trees lose their leaves in the fall, so how can they start growth again in the spring without any food factories?

Before the advent of cold weather a tree stores up plant food with which to start growth in the spring. The first leaves start from this reserve, and in turn the leaves become factories to prepare more food, from which the growth of the tree goes on.

But plant food, even after preparation in the leaf, is not a living part of the tree. An agency is required for the transformation, just as an agency is required to change our food into living body. This agency, in case of a tree, is performed by a layer of cells, called the cambium layer, between wood and bark.

All union and healing, taking place after the operation of budding

and grafting, is done through the agency of this layer, operating with the food supply at its command.

By removing a section of bark from a vigorous young pecan sprout in the spring, a considerable mass of cambium cells can be scrapped up with a knife. An exposure to the air for a period of about a minute will turn the mass brown, and an exposure of about two minutes will turn it black. The cells are then dead, and a bud placed upon them would not live.

In the light of these observations three important points in budding and grafting can be plainly seen: (1) Cambium must be brought into contact with cambium; (2) it must be quickly done; (3) the cuts must be tightly sealed.

SELECTION OF TREES TO BE WORKED.

Constitutional Vigor:

When it has been decided that the pecan trees on the farm are to be worked over, the first step is the selection of the proper trees. In this connection the item of the greatest importance is constitutional vigor. There seems to be no other class of trees that varies so widely among its individual members in their fruit production as does the pecan. Of two trees near each other, budded to the same variety, of the same age, and growing in the same soil, the one may produce only ten pounds of nuts, while the other produces a hundred pounds, all because of inherent weakness in one stock and inherent vigor in the other. Therefore, in the event of choice between a small tree and a larger one, or between a tree in exact position and one a little out of line, let the matter of constitutional vigor be the deciding factor.

Position:

In any deep fertile soil pecan trees should not stand nearer together than sixty feet each way, while in deep alluvial valley land seventy feet each way is better in the long run. However, trees in a single row might stand much nearer together than sixty feet, as they would not be exposed to competition on all sides.

Of course it will not be possible to arrange native trees already growing on the land into perfectly straight rows, but the field should be staked off into squares, and the tree nearest to a stake, size and constitutional vigor being considered, should be chosen. This will fairly proportion the ground area and air space among the trees and will also, to a greater or less extent, approximate straight rows.

Size:

From sprouts to trees a foot in diameter marks the practical range of trees for budding and grafting. The larger trees are more difficult to work, particularly by the inexperienced, and it would be better,perhaps, for beginners to choose the smaller ones.

It is possible to top-work trees that are more than a foot in diameter, but since it is bad practice to cut back branches beyond two or three inches in diameter, the time and expense involved in cutting back, inserting buds, after care of buds, removing sprouts, etc., render the operation impractical.

Shape or Form:

The best height at which to head a pecan tree is some five or six feet above the ground. This will allow room for cultivating under the tree, and will at the same time be low enough to make the gathering of the nuts easy.

In case of choice between two otherwise equally desirable trees, the one heading high and the other braching some five or six feet above the ground, choose the latter.

In case of choice between two otherwise equally desirable trees, the head of one being composed of two or three large limbs, and the head of the other of five or six smaller limbs, choose the latter, unless the size of the former tree is such that its two or three branches are under two inches in diameter. In that case the former tree should be chosen, as requiring less work in budding or grafting.

The reason for choosing smaller limbs is that their ends heal over more quickly after being cut, but this does not enter as a deciding factor below two inches in diameter.

(All the above remarks are intended to be applied to trees of considerable size).

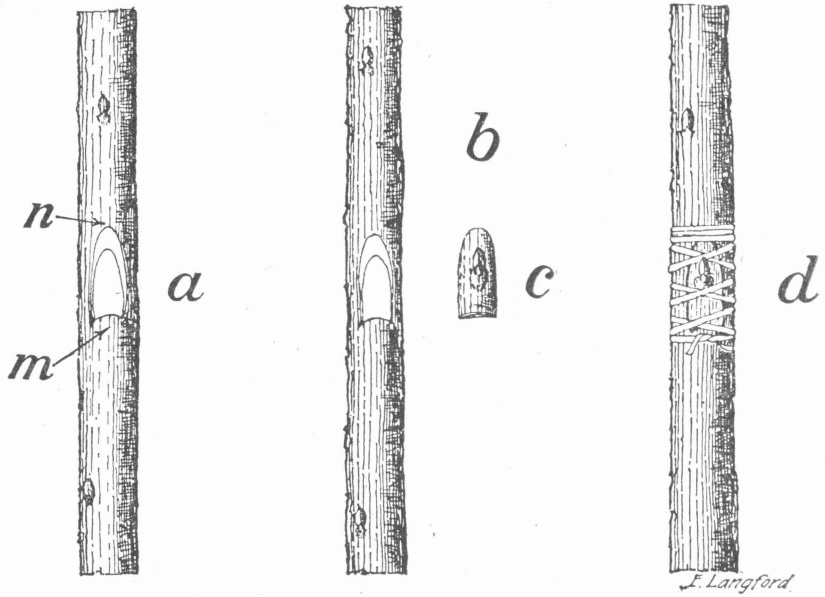


Figure 1.

(a) Matrix cut in stock for bud; (b) scion with bud; (c) bud which has been cut to fit the matrix; (d) bud in place on stock, tied and waxed.

CHIP-BUDDING.

The first method of budding in point of season is chip-budding. It derives its name from the small chip cut from the scion and inserted in a notch cut for it in the stock.

The illustration, Figure 1, will make the operation quite clear.

Chip-budding can be successfully done during only a short period, say three or four weeks preceding the rising of the sap in the spring. It is not intended to assert that not a single chip-bud ever sets after this period, but, in comparison with other methods, such a small percentage of union is secured as to render useless its further employment during the season.

The matrix or bed for the chip-bud may be cut at either a node or an internode—that is, at a bud or between buds. The latter has the advantage of being more likely to result in a smooth cut, as there is generally a gnarl underlying a bud, and it is best to choose a smooth place between buds.

In preparing the matrix for the bud, use a sharp knife, making a downward cut at an angle of forty-five degrees, extending through the bark and a very little way into the wood. (See Figure 1, m). Next move the knife up about an inch above this incision (Figure 1, n) and make a smooth cut downward, going through the bark and taking a little wood, thus removing the chip.

Next cut a chip bearing a plump, vigorous bud in like manner from a scion, or bud-stick, about the same size as the stock on which the matrix has already been prepared, being sure to get this chip long enough for its new bed (Figure 1, c). If the chip is too long for the bed, the bed can be made longer by cutting out; but if the bed is too long for the chip, there is no remedy except by the use of another bud.

In the effort to secure a good fit of bud-chip and matrix particular attention should be given to the shape and size of the wood on the inside of the bark of the chip. The thin cambium layer lies around the edge of this wood, and if the cambium of the chip does not connect with the cambium of the stock there will be no union.

The thickness of the bark of different pecan trees varies, and it is obvious that if a chip be taken from a scion of thin bark and placed on a stock of thick bark, the cambium layers will not connect in case of a perfect fit on the outside. But if attention be paid to the shape and size of the wood-cut in both bud-chip and stock, and these be made to correspond, the cambium layers will connect, although there may not be a snug fit on the outside.

It is probable that more unsatisfactory results have come from efforts at chip-budding by failure to observe this important point than from any other cause; and it often happens that the most careful operator secures poorest results for the very reason that he always gets a snug fit of bark to bark on the outside.

The Texas Prolific has very thin bark, and buds from it have been considered most difficult to put on by the chip-bud method, when, in fact, it is one of the easiest of all varieties to operate, if attention be given to the point above suggested.

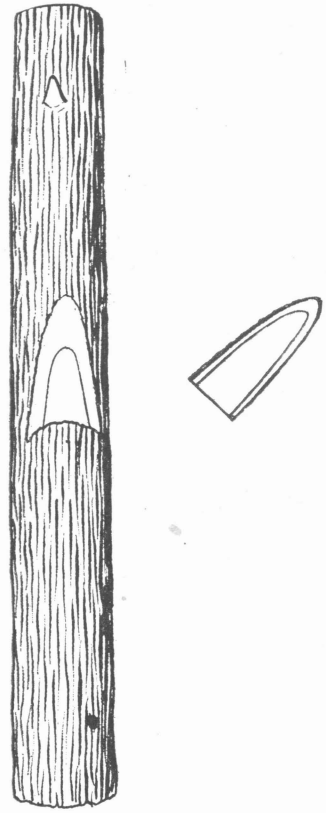


Figure 2.

A matrix cut in a stock with thick bark, and a chip-bud (inner side of cut) cut from a scion with thin bark. This bud-chip would make a snug fit, outside, but notice the difference in the wood-cut of the two. The cambium layer is around the edge of the wood, and should connect in stock and scion. This matrix should be cut larger, irrespective of the outside fit.

After securing a good fit, as indicated, wrap the bud carefully to the stock, using both hands, back and forth, being sure to tie down well at both ends. (Figure 1, d). After tying, seal the edges of the cut well with wax. (Formula on last page).

It is not necessary, immediately, to do anything further to the limb or young tree on which a chip-bud has been placed. It would do no harm to the bud to cut off the stock a foot beyond it, and remove all native buds from that portion, because the tree is not active at the time, and the union of bud and stock must take place by the use of stored food. But if the bud-chip should fail to unite, the stock might be in better shape for patch-budding, later, if left uncut.

By the time the buds of the stock begin to show green, it will be easy to tell whether or not the inserted bud has united. In case it has, the stock should then be cut a foot beyond it, and all native buds on that portion rubbed off. It is well, however, except in case of very small trees, to leave some limbs below the inserted bud, or allow the development of some new shoots there. The leaves on this outgrowth will keep the stock in a healthy, growing condition until the development of the growth from the scion enables it to perform that function.

When the scion has obtained a growth of from six inches to a foot in length, the cutting away of these lower branches should begin. They should not all be removed at one time, but gradually, at two or three cuttings, extending over a period of about a month. Henceforth remove all growth except from the scion.

The object of leaving a foot or so of the stock above the bud is to use it as a support to which the new growth from the bud can be bound. This portion should be cut away the following winter.

The string binding the chip-bud should not be cut as early as should the string binding the patch bud. No definite number of days can be

stated, since the process of development in different buds is so varied. As a general rule the string should not be cut until its cutting into the bud-chip renders the operation absolutely necessary. In the process of union the cambium cells form a ring around the edge of the cambium of the bud and the cambium of the bed or matrix; and if the string be cut too soon, this rapidly growing ring will raise the chip out of its matrix, leaving it unsupported save by the yet soft deposit of cambium, thus rendering the new branch an easy victim to wind or accident. When it is time to cut the string let it be done by passing the knife across the folds of the string on the side of the stock opposite the bud. Do not attempt to unwind the portions of the cut string—leave them alone.

ADVANTAGES AND DISADVANTAGES OF THE CHIP-BUD.

The chief advantage of the chip-bud lies in the fact that it can be used in advance of spring, before the bark will slip so as to render possible the operation of patch-budding. This advantage is considerable when there is much budding to be done and an early start is necessary.

It also enables the operator to use buds from gnarly bud-sticks, which buds are not suitable for use in patch-budding.

The union from the chip-bud is also one of the best, once secured and matured, and possesses the added advantage of a longer period of growth by reason of its early start.

The chief disadvantage of the chip-bud lies in the delicacy and absolute accuracy required in the operation, rendering a high percentage of living buds difficult to secure, even in the hands of the experienced operator, and in the hands of the novice, next to impossible.

Chip-budding requires that stock and scion be approximately the same size, in order that the cambium in the bud may meet the cambium in the stock. This is a very limiting factor, both in securing buds and selecting locations for them on the stock.

BARK GRAFTING.

This was formerly considered one of the most important of all methods of operating pecan trees, because of its adaptability to top-working trees too old, too large, and too thick of bark to admit of patch-budding without first growing new sprouts on which to bud. However, the discovery that the patch bud can be successfully placed in the thick bark of large limbs, and in that of trees of considerable size, has robbed this method of much of its importance. Still it deserves treatment because it makes possible the use of rough gnarly scions that could not be used by any other method.

The operation can be easily understood by examining the following illustrations (Figures 3, 7 and 8).

In connection with the subject of bark grafting certain questions will naturally arise, some of which are here suggested:

(1) When does the season for bark grafting open and when does it close?

(2) What is the very best time for the work?

(3) When should the cutting back be done?

(4) How far back on the tree should the cutting extend—that is, how large a branch is it admissible, under best usage, to cut?

(5) What should be the condition of these cut-back limbs at the time of grafting?

(6) Why should some lower branches be left uncut?

(7) What percentage of the limbs should be left?

(8) How large a tree can be top-worked?

(9) At what point should a limb be cut?

(10) When should scions be cut, and how kept pending use?

(11) What should be the condition of the scion at the time of grafting?

(12) How should a scion be cut for the purpose of inserting?

(13) What steps are to be observed in inserting, tying, and waxing?

(14) What should be the size of a scion, and how many buds should it have?

(15) How many scions should be used on a given stock?

(16) What after care should the graft receive?

These questions will be answered in consecutive order:

Season (1): The work can be done as soon as the bark will slip in the spring, and it is possible to perform the operation successfully any time during spring or summer, provided there is abundant sap in the tree. To do so, however, would necessitate the carrying of scions in cold storage for a long time. Then, too, a graft cannot be carried over dormant, after being put on, as can a bud, because the cutting back, necessary to do the work, would force out the buds of the scion, and, when the work is done late in the season, the immature new growth from these buds might be killed by a freeze.

The practical range of the season is about forty-five days.

Best Time (2): The very best time for bark grafting is when the buds first swell in the spring, and for thirty days thereafter.

Cutting Back, When (3): The cutting back should be done when the grafts are to be inserted. If done too early there will be a dead portion of half an inch or more at the end of the stub, and this would interfere somewhat with the grafting.

Cutting Back, Size (4): Branches should never be cut back beyond four inches in diameter. Two inches and under is better, but in extreme cases it is sometimes necessary to cut to three or even four inches. It should be remembered, however, that the larger the wound the longer it will take to heal; and in case of very large wounds complete healing-over may never take place. In such case, the exposed portion of the end of the cut limb or tree will eventually decay, leaving a hollow. This hollow will catch and retain rain water, leading to further decay, and possibly

to the final destruction of the tree. The weakened grafted portion may at any time prove an easy victim to storm.

Condition of Stock (5): The condition of the tree at the time the scion is inserted should be active, that is, the sap should be up. Evidently there will be a slight cavity around the scion, notwithstanding the use of the wedges hereinafter recommended, caused by the raising of the bark of the stock when the scion was inserted. (See Figure 3, v and x). This cavity should be quickly filled with new tissue, and the scion built up to, in order that union may take place. Hence, the necessity of the most active condition of the tree.

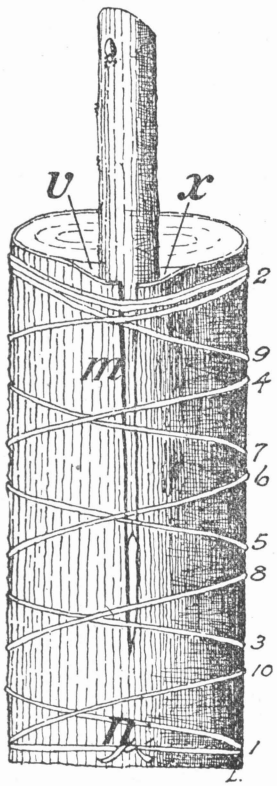


Figure 3.

Bark grafting as it was formerly done. Notice the openings at v and x. These openings can be largely prevented by paring the bark of the stock thin before inserting the graft, and by using wedges between the strings and the bark of the stock (see Figure 8). Before attempting to do bark grafting by the new method be sure to read the answer to question 13 under that head.

Lower Branches (6): Some limbs are left below the cut ones to furnish leaves necessary to the health and continued growth of the tree while the new top is being established. They should be cut back the second year, and worked like the ones above, if they are as high as five or six feet above the ground—this being the ideal height to head a pecan tree—but if they are nearer the ground than five or six feet, they should be smoothly cut close to the body of the tree during the winter following the grafting, and the entire growth forced into the new top. Each particular tree, by reason of the infinite variety in form, becomes a separate subject for consideration.

Limbs Left, Percentage of (7): In preparing a tree for top-working, about one-fourth of the limbs should be left. This is sufficient to furnish leaves to maintain the tree in a healthy condition.

In case of cutting back a tree of considerable size for bark grafting late in the season, after the tree is in full leaf, the entire top should not be cut away. (See Figure 5). At least one of the main top branches should be left to bring sap up to the base of the stubs, (a), (b), and (c), Figure 5. These stubs should not be too long as to make the scion too far from the base of supply.

The lower branches should be patch-budded during the season (Figure 11) and the buds carried over the season dormant. The branches should then be cut back and the top cut out close to c.

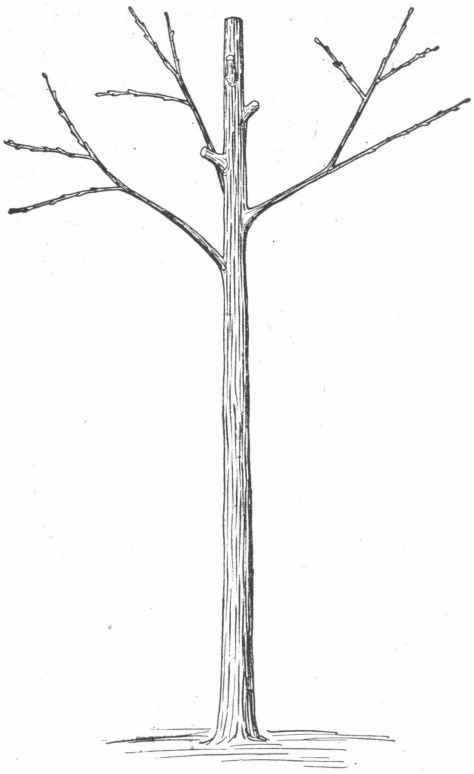


Figure 4.

A tree cut back ready for top-working early in the spring. It is about eight inches in diameter, and the lower branches are six or seven feet above ground. The lower branches will furnsh leaves for first year, while the new top is being established. These lower branches can be cut back and grafted the following spring—or better still, they can be patch-budded according to Figure 11, and the buds carried over dormant till the following spring, when it will be necessary to do nothing further than cut the limbs to force out the buds.

The uncut branch will not only serve to bring up sap, but the prepared plant foods, manufactured in its leaves, will aid the union of scion and stock, and help to heal the wound made in grafting.

In case of any operation on a tree after it is in full leaf, particularly if it be of considerable size, some leaves should be left above the wound.

When the work is done in early spring, and the union of scion and stock takes place by means of the stored plant food, the leaves that put out from the scoin will enable it to perform the necessary functions by the time the stored food supply becomes exhausted.

Size of Tree (8): Answering this question, in the abstract, without respect to the physical and financial limitations, it might be said that any tree, however large, can be top-worked. However, in the case of large trees, the trouble, time and expense incident to cutting back the branches to the proper size, and the difficulties encountered in the after care of the grafts, render the operation impractical.

As a general rule trees more than eight inches in diameter should not be attempted. This rule, though, is subject to exceptions. It often happens that the head of a pecan tree is composed of many small branches rather than a few large ones. In such cases the cutting back can be done without cutting limbs of too large size.

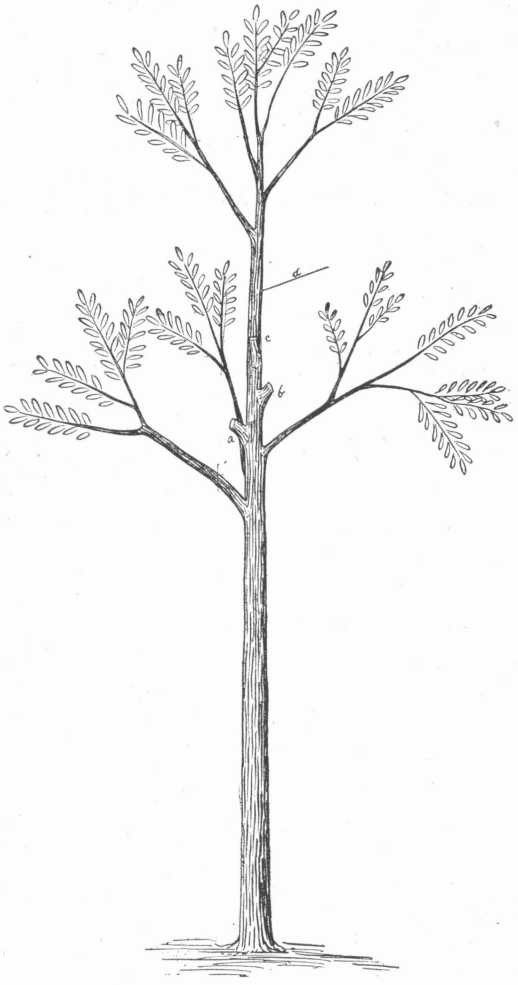


Figure 5.

The same tree shown in Figure 4, but in this case cut back for bark- grafting after it is in full leaf. Part of the top was left to nourish the grafts at a, b, and c. Note that the branches for some distanee above c, as at d, have been cut out to furnish air and sunlight to the growth for a, b, and c.

Cutting Back, Point (9): How far to cut back limbs from the body of the tree requires the exercise of some judgment. Generally about a foot is a good distance. However, the size and condition of the limb should control over distance. A limb should not be cut where it is too large, and a scion should never be inserted in a curved, gnarly, or knotty place. Select a straight section where the bark is smooth and even.

Scions Obtained When, and How Kept (10): Propagating wood to be used should be cut before the sap rises in the spring and should be kept in cold storage wrapped in damp moss or sawdust at nearly freezing temperature. In this way it can be carried for several weeks, provided the moss or sawdust be kept moderately damp. An ordinary ice house serves the purpose very well when the scoins are not to be kept late in th eseason. However, the temperature of an ice house is likely to be variable, and at some time it may be high enough to allow the buds to put out. many buds have been lost in this way, and many have also been lost by failure to keep the moss or sawdust moist. For very late work, by the bark-graft method it is better to order scions when needed from some nursery that has regular cold storage facilities.

Where trees for obtaining scions are available, and the operator desires to cut them for himself, they can be carried dormant for some time either in an ordinary ice house or by burying a foot deep in the ground, in

a cool shady place on the north side of some building. In the later case care should be taken to protect the wood from an excess of moisture by covering with boards and by ditching to drain the water away.

Generally speaking, the condition necessary for keeping buds is the presence in only limited quantities of light, heat, and moisture; and any contrivance that will accomplish this result can be used.

Figure 6.

Figure 6 represents a ridge of growth, called a callus, made from reserve plant food, at the end of a scion. It is by means of this growth, and a like one made by the stock, that graft and tree grow together; and, had the scion been in place on the stock at the time growth was being made the two would have united. The particular scion from which this drawing was made had been carried, in damp moss, over the state for some two or three weeks during April, and the buds on it were turning green. It is too late to use a scion after it has reached this stage of development.

Condition of Scion (11): Scions should be used when activity first begins—just as soon as the bark begins to slip. A graft put in after it has exhausted its supply of stored food can not unite, and a perfectly dormant one goes through too long a wait before the active processes of growth begins.

Perfect dormancy of the graft was formerly emphasized in order to allow time for the openings around it, (Figure 3, v and x), to fill with new tissue. Since then, however, means have been found to almost entirely prevent these openings, and the sooner the active processes ensue after the graft is inserted the better.

Cutting Scions, How (12): For cutting scions for bark-grafting a sharp knife is necessary, and a blade with a round or budding end is best.

The callus on the end of the scion (Figure 6) would have been thinner if the cut surface had been longer, as the same amount would have been deposited over a greater length. This, of course, would tend to lessen the chance of union. But, since a longer union is a stronger union, being formed, it is thought that a cut from one and one-half to two inches is best.

The surface of the stock is curved, and the cut surface of the scion will be flat if made by a straight blade. It was formerly thought that this flat surface should be hollowed out in order to make is conform to that of the stock. It is not thought that a slight space between the cambium of the scion and the surface of the stock may be of a distinct advantage in allowing room for a sufficient deposit of tissue to form a union. At any rate, it is not necessary to hollow the flat surface of the scion, except in case of placing a rather large graft on a rather small tree, when the divergence would be too great.

In addition to the cut surface on the front of the scion (Figure 7) some operators prefer to make a slight short cut on the back also, just going through the bark and taking a little wood.

Examination of a number of unions showed that a majority of them started at the lower inside of the scion. For this reason, and for the further one that the cut on the back would necessarily break the continuity of the ring of the union, it is now advised to make only one cut.

Figure 7.

A scion that has been prepared for bark-grafting. The cut is straight, and is one and one-half inches long.

Before inserting the scion be sure to trim the back of it, as far as it will be pressed down into the stock, all buds and rough places. This will prevent the parting of the bark from the wood of the stock for so great a distance, and will leave the work in nice smooth condition for wedging down, and closing the cavity around the scion, as shown under the next heading.

Inserting, Binding, and Waxing (13): Before attempting to insert the scion, trim the back of the stock thin in a place an inch or more wide, and a little longer than the cut surface of the scion (Figure 8). Be sure not to cut through the white bark—just remove the corky outer portion so as to make it flexible—then when the graft is pushed down, the bark will give and not separate from the wood for a long distance on each side.

When the bark has been properly trimmed, slit it through the center of the trimmed place as far as the scion will extend when inserted, and lift up the edges a little, gently, with the point of the knife. Push the scion down until the cut surface is covered, tie well with strong, soft twine, and wax over string and all. (First waxing). After waxing, make two wedges from a small limb, and insert one on either side of the graft, between the string and the bark of the stock. Make a neat job of it, being sure to cut the wedges off smooth with the stub of the stock. The wedges should be thin at the bottom and thick at the top, and designed in shape to reduce the opening about the scion. If they will not go down by gentle pressure, trim them so they will do so. Reference is made to the statement that a binding string or wire around a young tree will stop the passage of plant foods by closing the longitudinal cells, and any considerable pressure of the wedges against the bark of the stock would entirely stop all processes of activity through the particular portions pressed upon.

It is not the object, in the use of the wedges to close entirely the cavity on each side of the scion, but to reduce it to a very small one, immediately along the edge of the scion. Same space is necessary for the deposit of new cells to form a union. This deposit begins, always, at the line where the bark of the stock parts from the wood; and in its growth, it builds toward the graft. Consequently, if the space be large, the graft may perish

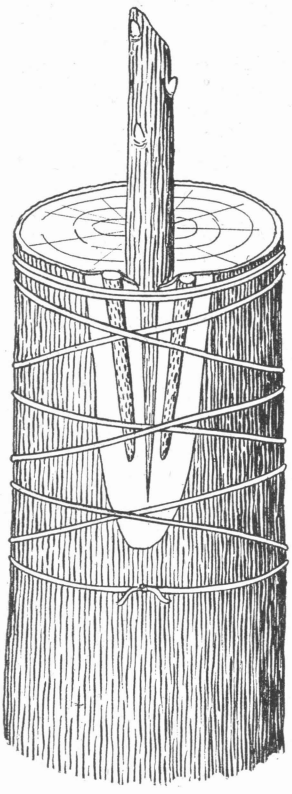


Figure 8.

A bark-graft, inserted, tied, and wedged. Note that the bark of the stock has been trimmed to make it flexible. Also note the wedges between the bark and the strings. These wedges almost close the openings around the graft, and cause what little openings there are to be immediately along the edges of the graft.

before this growth reaches it and unites with it.

The wedges serve to prevent the lift-up of the bark of the stock from around the graft in the drying-out after cutting and trimming.

After wedging rewax liberally (second waxing), entirely covering over wedges and all, being sure to coat all the trimmed portion of the bark lightly, in order to seal. The wax may cost a cent or two, but the expenditure will pay.

After this second waxing, wrap with a strip of cotton cloth about an inch wide, first taking a hitch or two around the graft, and continuing in descending spirals around the stock. The end of the cloth can be either stuck down with a little wax or tied with a string. It is not necessary to cover the top of the stock with the cloth.

The use of the cloth is not absolutely necessary, but it obviates the necessity of future re-waxing, prevents the entry of insects and keeps bees from removing the wax.

Size of Scions and Number of Buds (14): There seems to be little limitation as to the size of the wood that can be used. In general practice sizes ranging from a cigar down to a lead pencil are employed. These sizes, however do not represent the extreme limits of range. The size of the scion bears some little relation to the size of the stock on which it is to be used, though that relation is not definite—in general, larger scions on longer stocks, and smaller scions on smaller stocks.

All newly grown wood with large pithy centers should be discarded.

There should be from two to four buds on the protruding portion of the scion. Theoretically one bud is enough, but to meet the contingency of accident more should be left. However, it should be borne in mind that the greater the protruding portion of scion, the less chance of living. Each of its buds will require to be nourished by sap through the stock, and if there be too many buds they may die before a good union is effected.

Number of Scions (15): A very good rule to govern the number of scions is one for every limb two inches in diameter and under, and one additional for every increase of one inch in diameter over two inches. By

this rule a three-inch limb would have two scions, and a four-inch limb three scions.

If more than one scion is used in one limb, all the resulting branches except the best one should be cut away when the end of the limb (stock) is completely healed over, the extra scions having been intended for no other purpose than to assist in this healing. Several branches arising at the same point will, if let alone, form a crotch of such nature as to render likely the subsequent splitting out of the limbs by their own weight.

After Care of Scions (16): If the work has been done according to the preceding directions, it will need no further attention before it can be told whether or not the grafts are going to live.

It is thought that the reduction of the cavity about a graft will tend to promote union; but, on the other hand, it is possible that the pressure of the wedges would sooon retard growth by preventing a large cambium deposit at the place of union. Accordingly, when the growth from the graft is well started, the cloth wrapping should be taken off, the wedges pushed out, and the cloth put back. This will provide for expansion at the place of union, and will doubtless result in accelerated growth.

Numerous native sprouts will put out near the ends of the cut-off limbs. These sprouts should not be removed at once, except those in the immediate proximity to the graft. They will serve as a support to the new growth of the scion, and will aid in the formation of new tissues. The growth of the graft will be greater by reason of their presence for some time than it would be without them. They should be removed by degrees, as the growth and developmnet of the grafted portion enables it to perform the functions of a top with less and less assistance. There is no hard-and-fast-rule—one graft will grow more rapidly than another. Generally, all native sprouts should be removed by midsummer.

Except the removal of some native sprouts, no other attention will be necessary for about a month after pushing out the wedges, when it will be time to cut the binding strings.

The strings should be cut by passing a knife across them on the side of the stock opposite the graft, cutting through both wrappings and strings.

After the strings are cut it is necessary to support the new growth by wrapping it to a stay, which may be either nailed or tied to the stock. This precaution should not be overlooked, and the results of all former labor lost in a windstorm. "What is worth doing is worth doing well," and what is worth doing well is worth following up well. Supporting the grafts may be a little trouble, but it is not the object of this bulletin to tell how to graft pecans **without trobue**, but rather with its aid.

(If a bark graft fails to grow—and some of them are going to do that—the best native sprouts should be saved and budded by the patch-bud method during the month of July.

Sprouts of this character, issuing through the thick bard of old

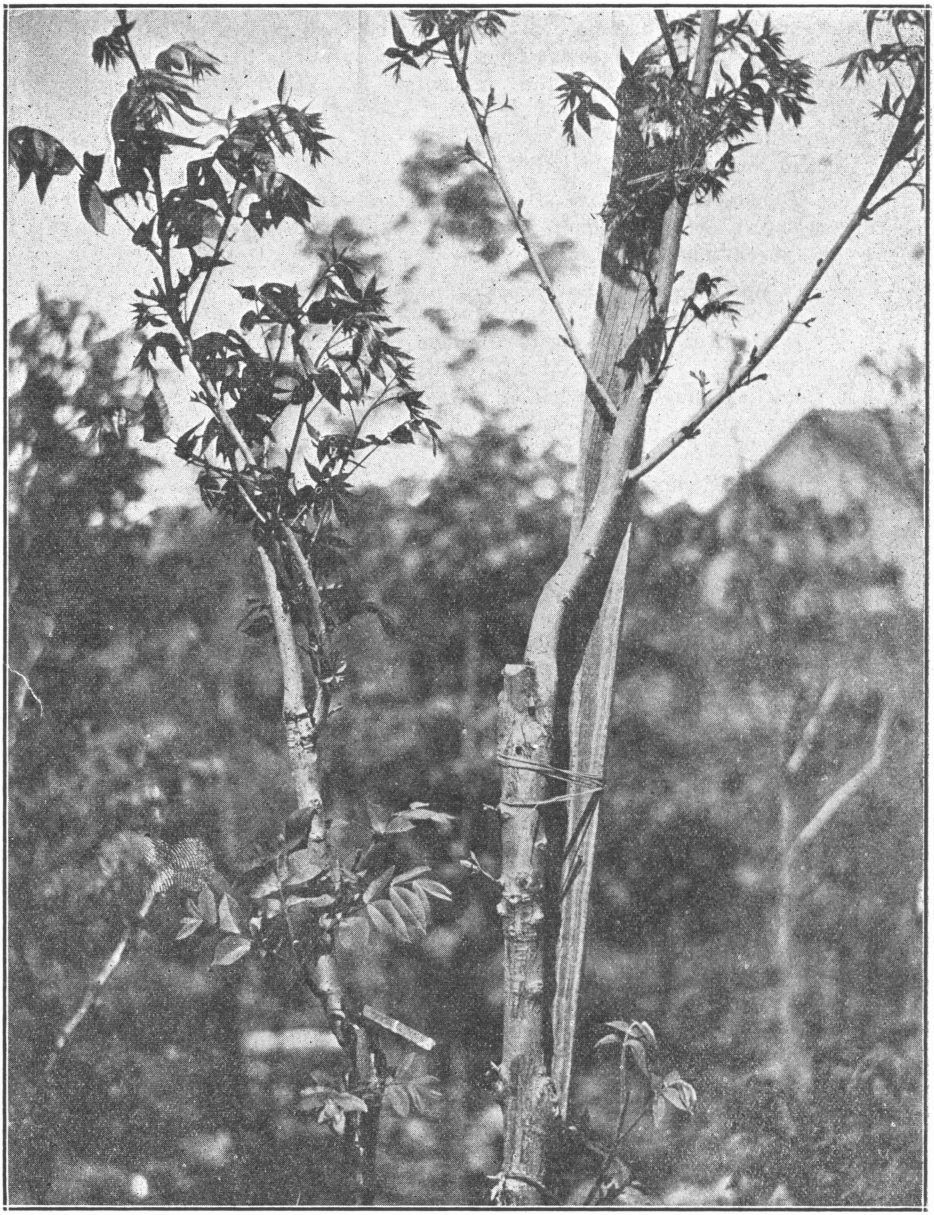


Figure. 9.

Figure 9 is a photographic reproduction of a book-graft and a patch-bud put on in demonstrating to a class at A. and M. College, April, 1918. Note the board supporting the graft to prevent its blowing out before forming a strong union.

trees, are likely to become constricted by the bark at the points of issuance. The deposit of growth from the new sprout is likely to be on the outside of the bark, rather than in contact and union with the wood of the tree. There will be only a small stem of wood through the bark, joining the limb, outside, to the wood, inside; and when the limb attains sufficient weight the stem will break.

To prevent this condition the bark around the place where the sprout issues should be pared thin, and some gashes should be cut close to the sprout on either side).

OBSERVATIONS ON BARK-GRAFTING.

It is often convenient to combine bark grafting with patch budding. When a limb is cut back, for instance, to force out a patch bud, and there is doubt as to whether or not the bud will grow, a graft can be inserted at the time of cutting, and the chance of success thereby increased.

The predominating disadvantage of bark-grafting lies in the comparative ease with which the grafts are blown out; and, for this reason, too much stress cannot be laid upon supporting them well.

During the spring of 1918 bark-grafting was largely a failure in Texas, because of the very dry summer and fall of the preceding year. The scions had an insufficient supply of stored food, and the stocks were also in poor condition.

This system of work is not recommended for general practice following droughts during the late summer and fall of the preceding year.

PATCH-BUDDING.

Taken all-in-all this is by far the most important method of working pecan trees. Since the discovery that patch-buds can be successfully placed in the thick bark of large limbs and trees of considerable size, it bids fair to largely supplant the use of the bark-graft. It possesses, over the bark-graft, several distinct advantages: (1) it brings the entire camblum surface of the scoin into intimate contact with that of the stock; and, for this reason, a much higher percentage of success can be attained by its use than by any other. (2) It can be used from April to October, rainfall being sufficient. (3) It makes it possible throughout the season to take buds, fresh, from one tree and place them on another—in fact, such buds are best—while only storage wood can be used for grafts. (4) A given number of buds will go much further by its use than by grafting. (5) It obviates the necessity of cutting back the tree until it can be seen that the buds are living. (6) It makes it possible to form the head of a young tree, tall and without low branches, at any height and in any shape desired. (7) Where only one graft can be placed at a cut, two or more buds can be placed without cutting, thus increasing the chance of success.

For these reasons the patch-bud is recommended for general use.

The patch-bud is the same in principle as the ring-bud, the only

difference between the two being that the ring-bud extends all the way around the stock, while the pach-bud extends only part of the way. The ring-bud is open to the objection of requiring the use of buds from scions of approximately the same size as the stocks upon which they are to be

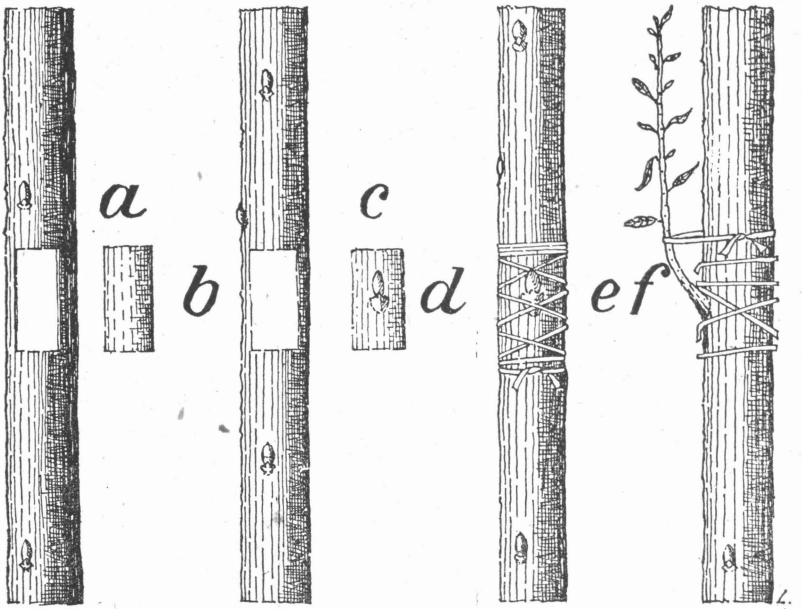


Figure 10.

(a) Stock with section of bark removed; (b) the section removed; (c) scion with section of bark removed; (d) section of bark containing bud removed from scion; (e) fine bud in place on stock after having been wrapped, tied, and waxed; (f) new growth tied to stub of stock left for that purpose.

placed, which is a very limiting factor in securing good buds. A patch-bud can be taken from a scoin of any size and placed upon a stock without reference to their comparative sizes. The matrix of the patch-bud also presents shoulders for the bark of the scoin, which prevents its slipping while being tied-in. This greatly facilitates and hastens the operaton of budding.

For the above reasons, and in consideration of the fact that the patch-bud answers in all other respects just as well, there can be no doubt of its general superiority over the ring-bud.

A good general idea of patch-budding may be had from the accompanying cut, Figure 10.

Concerning the operation of patch-budding certain questions will naturally present themselves:

(1) At what season can the work be done?

(2) What size and age of trees and branches can be successfully budded?

(3) What should be the condition of the stock at the time of budding?

(4) At what point on the stock should the bud be placed, and should it occupy the position of a native bud removed?

(5) What characterizes the best buds for use?

(6) How many buds should be used on one tree?

(7) What should be the size and age of bud-wood, or scions?

(8) What should be the condition of the wood at the time of budding.

(9) How should bud-wood be kept pending use?

(10) How long should the removed section of bark be from top to bottom, and also how wide across?

(11) What sort of string should be used for tying, and with what force should it be drawn?

(12) How much wax should be used in sealing the cut.

(13) Should the bud be tied or waxed first?

(14) How long before the string should be cut?

(15) What after care is necessary to make the bud put out and continue to grow?

(16) What is the best kind of knife for patch-budding?

(17) What precautions should be observed in transferring the bud from scion to stock?

These questions will be answered in consecutive order:

Season (1): This work can be done at any time after the bark begins to slip in the spring until it sets in the fall, though the best time is in early spring. After the first of July buds can be taken from the current season's growth, though such buds are not as good as either storage buds or buds from one and two year old wood on the trees. Buds put on after the first of July should not be forced, but left dormant during the season. This can be effected by leaving the top and all the branches on the stock till winter, when the branches should be removed and the top cut off just above the bud.

This rule of leaving the bud dormant after the first of July will admit of some slight variation to conform to seasonal conditions, principally rainfall. The reason for leaving the bud dormant arises from the danger that a sprout from it might not attain sufficent size and maturity to go through the winter. But if rainfall has been abundant, and the stock is in vigorous condition, an early July bud may be forced with reasonable assurance that it will get in condition to withstand the cold. However, it should be added that nothing will be gained by forcing even under these conditions. The cutting back of the tree in mid-summer sufficiently to cause the forcing out of the bud will weaken the tree to such an extent as will more than counter-balance the temporary gain in the new sprout. In short, the dormant bud will overtake the forced bud the following season.

Size of Stock (2). On page 22 of a former bulletin, B-35, issued by the Extension Service of the A. and M. College of Texas, the following statements occur:

"Patch-budding can be done on young trees and small limbs from the size of a lead pencil up to three-fourths an inch, or more, in diameter. The limiting factor in budding to large stocks is rather the condition and thickness of the bark than the size of the limb or tree. Usually the bark gets to be thick, rough and corky by the time the tree or limb has grown to the diameter of an inch, and such bark is not suitable for budding. Doubtless the operation could still be successfully performed if buds could be gotten in the same kind of bark; but long before bark has reached this condition all buds have put out, a few of them making branches, but most of them dropping off.

"A necessary condition in patch-budding is approximate equality in thickness of bark of stock and scion; but this is so nearly always the case within the limit of one-fourth and three-fourths an inch as to need little consideration within those boundaries.

"Generally speaking, a patch bud may be placed at any good smooth spot where the bark is not too thick, though it is well to use buds from the oldest sticks in the collection for the large stocks, and buds from the young sticks for the small stocks. In other words try within a certain measure, to match the bark of scion and stock."

At the time this bulletin was written it was clearly recognized that "The limiting factor in budding to large stocks is rather the condition and thickness of the bark than the size of the tree." Since then it has been discovered that large limbs and trees of considerable size can be successfully budded by first paring the bark of the stock thin, and placing the bud in the middle of the pared place. In other words, thickness of bark is under control by trimming. The only precaution necessary to observe is not to pare so thin as to cut through the bast cells in the inner portion of the white bark, through which the food supply comes.

The paring of the bark, and the wound made for placing the bud, cause a considerable cambium deposit at the place; and this deposit is much greater on a large stock than on a small one. It is, therefore, probable that a higher percentage of success can be attained with rather large stocks than with small ones; but, on account of the heavier cambium deposit, it is necessary to give closer attention to the budding strings, and possibly to cut them sooner.

Whereas the limiting factor in budding large stocks used to be thickness of bark, it is now the size of wound that will heal-over after cutting-back to force out the buds. In this the same rule will apply as in case of bark-grafts, two inches in diameter and under.

Condition of Stock (3): The very best time for patch-budding is when the buds begin to swell early in the spring, just as soon as the bark will slip. At this period the new bud has the advantage of being assisted in healing by the use of the reserved food carried through the winter, soon followed by the flow from the new leaves.

Subsequent to this time, that is, after the leaves are developed and

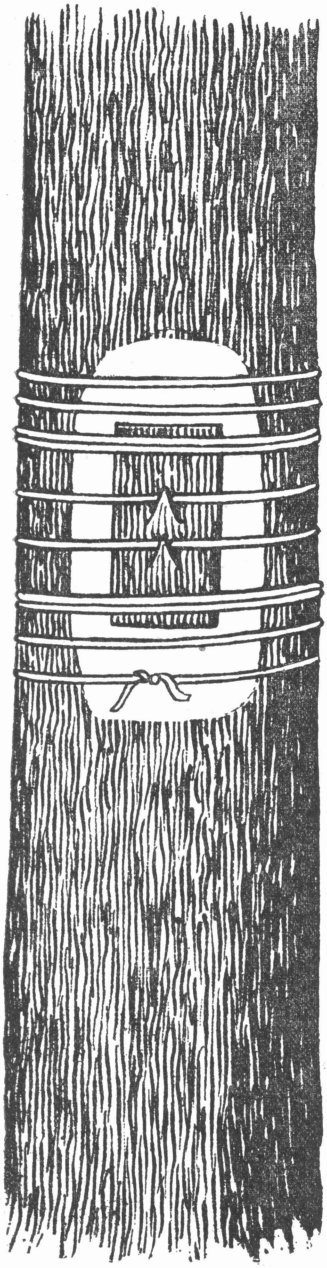


Figure 11. A patch-bud in a trmmed spot on a pecan tree about one and one-half inches in diameter. Particular attention should be paid to the thickness of the bark of the stock along the sides of the bud-bark. If the bark of the stock be thicker there than is the bark of the bud segment, the strings cannot press the bud segment down as it should be.

Note the strings just above and below the bud segment. These strings are to prevent any lifting-up of the bark around the bud segment in the drying out process after trimming. It is important to wax over all this pared portion.

the main process of healing depends upon the newly prepared plant food, the stock must be in the most active condition.

Elsewhere is the statement that patch-budding can be done from the opening of spring till the beginning of fall. Any limitation upon this statement will be by reason of condition of stock and not by time of year. It would be useless to place buds on a tree when there was no "sap" to feed them. Cut a small section of bark from the tree to be budded. If the bark turns loose readily, and moisture is plentiful under it, the tree is in condition to be budded. If the bark does not slip readily, and moisture is scant or altogether wanting, a bud surely would die.

Avoid budding during long summer drouths and for some days thereafter, unless the stocks be strong, vigerous sprouts from the roots of old trees that have been cut down. Such sprouts have such an abundant root system to nourish them that they are generally in good condition long after young trees, depending upon their own roots, are unfit for budding.

Position of Bud (4): The proper position of the bud on the stock depends upon the size, development and shape of the tree to be budded.

In the growing of nursery stock for use in Texas, the bud should be placed close to the ground. Much difficulty has been experienced in this state in getting nursery trees to grow after transplanting. The writer has seen acres of trees dying from sun-scald. The bodies of these trees, on the south and west sides, just at the surface of the ground, where they receive both the di-

rect and reflected heat of the sun, presented the same appearance as though a fire had burned them. To obviate this condition nursery trees should be severly cut back at the time of transplanting, and earth should be mounded-up nearly to the top of the stub. Now this mounding above the budded portion would be rendered impractical by budding too high.

In case of budding to branches, the bud should be placed near the body of the tree. A bud near the end of a limb will grow another limb, and this will make the combined length too great.

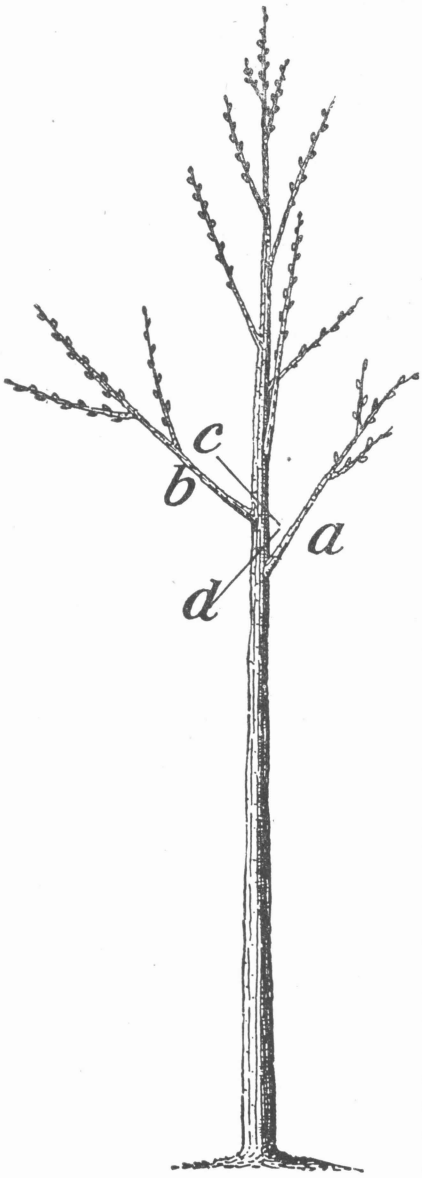
By referring to Figure 10, it will be observed that the section of bark (b) from the stock (a) contains no bud. This is as it should be, and indicates that the bark was removed from an internode, that is, between bud and bud. The wood in this position is smooth and even, while there is likely to occur a gnarl and slight projection under a bud, which might injure the bud of the scion when forcibly pressed against it in tying. On nice round young wood near the body of the tree these gnarls do not occur, and it might be better in such cases to place the bud at a node, as there is always a greater deposit of reserve plant food under a bud than elsewhere; but since an internode always presents a smooth surface, it is thought best to recommend it for general practice.

The shape of the limb or sprout to be budded has much to do with the correct placing of the bud. A straight smooth round place should be chosen. A bud should never be placed in a curve of the stock, unless the bud be taken from an exactly corresponding curve in the bud stick. Even this is risky, as the eye is not always able to judge accurately, and the effort may result in splitting the bark in which the bud is imbedded, and lead to its death.

It is better to place buds on tops of limbs rather than on the under side, in order to secure upright growth.

Good Buds (5): The best buds are those on the smooth round wood, near the beginning of a year's growth. Buds from near the tip of a limb should be rejected. They usually sit up on a ridge, which causes a hollow under the bud when it is removed. This hollow cannot be pressed down against the wood of the stock, and before it can be filled by new tissue the bud will have died.

Good buds can be gotten from two and even three years old wood. On thrifty growing sprouts there are sometimes three and even as many as four buds at a node. The primary one of these buds puts out the first year and drops off. The secondary bud the second year, and so on. This character of bud-wood is very desirable for use on well matured stocks, even when cut from nearby trees and used in summer. However, care should be exercised to see that the buds are alive, as some of them do not fall off for a long time after dying. If they are alive they will be flexible, and will give to pressure of the thumb nail. If they are dead they will be rigid, and will break off when pressure is applied.



Number of Buds (6): The number of buds to use on a particular tree is largely a matter to be decided by the judgment of the operator, with the tree before him. However, every beginner wants to use too many buds. One bud is enough for any small tree, and is usually enough for any tree up to two inches in diameter, if judiciously placed.

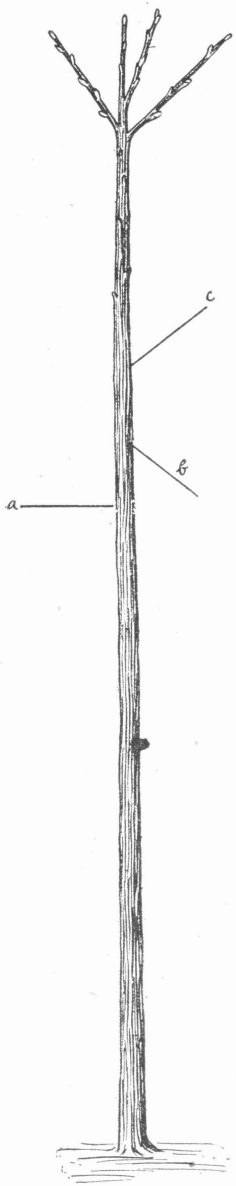
The beginner would be disposed to bud five or six branches of this tree, whereas it is necessary to bud only one, (a), near the body of the tree, and to force out the bud by cutting off (a) beyond the bud and also removing part of the top of the tree. The following winter the tree should be sawed off just above the branch (a) at (d), and all the growth forced into the new part. The wound will soon heal over, and at the end of two or three years the weight of wood grown from the single bud would equal the combined weight of that grown from six buds, had so many been used. Moreover, much time will have been saved in budding and much trouble in looking after the buds.

This illustration will suggest some idea of how to take advantage of the various forms, and will tend toward the adoption of the sound motto, **"Let the Tree do the Work."**

However, it is not intended to convey the idea that only one bud should be used per tree under any and all circumstances. In case of

Figure 12—This Figure represents a pecan tree two inches in diameter at the ground with the limb (a) four feet above the ground. If several of the limbs were budded, the head of the tree would be formed too low to admit cultivation under it. By budding the limb (a) only, the head of the operator—that is, the new growth resulting from the bud at (a) can, by pruning, be made to head at any desired height.

If the limb (a) were five or six feet above the ground, both it and the limb (b) shoud be budded, and the head of the tree thus formed.



larger trees several buds can sometimes be used to advantage—only do not use too many.

Bud Wood, Size and Age (7): Strictly speaking neither size nor age is a limiting factor in the use of bud-wood. Each of these items serves only as an index to condition. Wood can be used for buds as long as live buds remain on it, which is usually two or three years. During this time it rarely attains any considerable size.

Commercial bud-wood is nearly always of the previous season's growth, and ranges from the size of a lead pencil to that of a small cigar.

Condition, Ready for Use (8): In patch-budding it is always more satisfactory to use buds freshly cut from the trees, when it is possible to do so. This practice is, however, rather extravagant in point of the amount of bud-wood required, as a big proportion of all buds put out early in the spring, if left on the trees, and are lost to use for budding. For this reason, it has been generally found necessary to store a sufficient supply to last through the first month or so of the budding season.

When using stored wood by the patch-bud method the buds should be used just as soon as the bark on the bud-sticks will slip—the sooner thereafter the better. When put on at this stage considerable union has time to ensue while the bud is developing from its own food supply; if the bud is already developed at the putting on, it is likely to die before union can be effected and food supply established. A high percentage of success can not be accomplished with badly swollen or bursting buds. No doubt it would be better to perform the operation with dormant buds if it were possible.

If the buds on the stick will not slip when desired for use, they can be brought into condition by burying them a day of two in a shallow trench in a sunny spot of ground. If the ground is dry, water

Figure 13—This figure represents a pecan tree two inches in diameter at the ground, and ten feet high. It grew in a thicket in competition with other trees, reached up for light and air, and the limbs are too high to bud. Formerly it would have been sawed off six feet above the ground and a bark graft inserted.

It is now recommended to place three patch buds at a, b, and c, first paring the bark. The bud at a, is on the west side, about five feet six inches above the ground; the one at b is on the south side about six inches above a; the one at c, is on the north side about six inches above b.

After the buds have formed unions with the stock, the top of the tree should be cut off and the buds forced out in accordance with directions given under patch-budding.

the trench with warm water. Do not bury all buds at one time, but only a limited number to be used as needed.

(Upon several occasions the Pecan Specialist of the Extension Service was without bud-sticks from which the bark would slip, and was forced to use almost perfectly dormant wood in giving demonstrations in patch-budding. He gave the demonstrations nevertheless, explaining that the buds would probably die, as he had to literally whittle them from the stick. He was later surprised to find them living and growing. This emphasizes the importance of using buds just as soon as they can be gotten to part from the stick.

These remarks apply, of course, only to early spring budding, as buds cut from active trees always slip readily).

Keeping Bud Wood (9): Wood for early patch-budding can be kept in the same manner as that kept for bark-grafting, and reference is made to that article for information.

For all except early work, bud-wood should be cut, fresh, from the tree.

Length and Width of Bark (10): The section of bark taken from the scion, in which the bud is imbedded, should be about an inch long and about half-inch wide. A somewhat wider bark may be used on a large stock. The exact length and width are not material.

String (11): Some operators prefer raffia for tying-in buds, but ordinary cotton wrapping twine, not too large, seems to answer just as well, and possesses the advantage of convenience. A ball of it can be carried in the pocket, and the desired length pulled out and cut off each time.

In tying-in use only sufficient force to make sure that the bark segment of the scion is brought into intimate contact with the wood of the stock, as there can be no doubt that many buds are killed by the cutting-in of the binding strings. This is not a necessary result, if attention be given to the strings, but it is too often the result. One pecan tree may grow more rapidly than another, and the string on it would need cutting sooner. Failure to cut the string at the proper time might, and probably would, strangle the bud. Observation of so many failures from this cause suggested the trial of some substitute for the customary string. Ten buds that were put on early in October, 1919, were held in place by very small rubber bands, and every one of them lived and quickly formed a good union. It was not found necessary to tie the ends of the bands together. The lower end was caught and held by the first fold of the band around the stock, and the upper end was caught in a cut in the bark. Neither was it found necessary to cut the bands at all as the budding wax caused them to decay and break before they did any harm—if indeed they would have ever done any.

Ten other buds, put on at the same time, were held in place by very narrow strips of cloth. The strips were put on after the same man-

ner as the rubber bands, only the upper ends were stuck down with a little wax, and the whole of the front surfaces were coated lightly with wax to make them waterproof. Every one of these buds lived, though they do not appear so plump and vigorous as those put on with rubber bands.

While these experiments are too limited to warrant the announcement of their adoption, their success is sufficient to foster the hope that a difficult place in budding has been gotten over by their means.

Wax, How Much (12): In sealing the cut made in budding, only a thin glaze of wax is necessay, just enough to make sure the cut is sealed. There is neither use nor excuse for piles and daubs of it, though if some wax get on the bud it will do no harm.

Order of Tying and Waxing (13): Patch-buds should first be tied-in and then waxed. It would be impractical to reverse the order. The buds would not stay in place while the waxing was being done. The small binding strings can be easily waxed over.

Cutting the String (14): The time between the operation of budding and the cutting of the string binding the bud varies with the rapidity of development and growth of the stock. It ranges from two to three weeks. In case of a very active stock, union will probably be effected and the string be cutting into the bark in two weeks, while with a less active stock longer time will be necessary. However, a bud that has not set in three weeks will never do so.

When the strings are to be cut let it be done by passing a sharp knife across them on the side of the stock opposite the bud. Do not attempt to remove the pieces of the string as that may cause openings in the wax.

After-Care of the Bud (15): The attention necessary to force a bud out, and particularly to keep it growing after it is out, varies to such an extent with the condition of the bud and stock at the time of budding as to require some discussion.

Reference is made to the introductory remarks concerning the manner of growth of trees, as those remarks have a direct bearing on this subject. Let it be noted that the leaves are the food factories of a tree, where elaborated plant foods are manufactured to be distrbuted throughout its system.

Pecan bark will slip before the buds have swollen to any appreciable extent, and it is evident that, in case where a bud is put on just as soon as the bark of both stock and scion will slip, the healing will take place partially through the food reserve, as there are no leaves yet, and possibly will not be for another week or two. Manifestely, the portion of the stock above the bud would, under these circumstances, play a less important part than it would had the operation been performed later in the season. However, the top will, even in this case, do no harm for some two or three weeks.

As the leaf system develops and the circulation increases, the healing will depend to a greater and greater extent upon the portion of the tree above the bud.

It seems to be common practice in budding to cut back the stock to a foot above the bud at the time of budding, and to also rub off all buds on that portion of the stock. It would be better, especially in cases where the leaves are already developed at the time of budding, to leave the entire top to assist in healing the wound occasioned by the budding.

When union has fairly started, about three weeks after the date of budding, the top should be cut to the desired length and the native buds rubbed off above the inserted bud in order to force it out. This pruning can be done at the time of cutting the strings, the union of bud and stock having been accomplished.

Why has not a tree as many limbs as it has produced buds? Such would be the case if each bud developed into a limb; but hundreds of buds put out in slender form, turn yellow and drop off, only one here and there developing into a limb where needed.

Now this dropping-off is exactly what is likely to happen to the fine bud if the native ones about it, and particularly above it, are not destroyed—and it is the more likely to occure in that the native buds will in all probability get the start of it.

The object of leaving a foot of the stock above the bud is to use it as a support to which the new growth may be bound in the event it shows a disposition to grow horizontally. (See Figure 10, f).

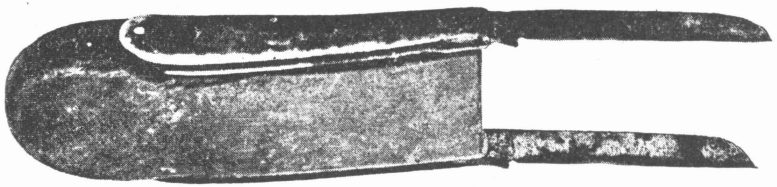
All limbs below the bud and its resulting sprout should not be removed at one time, but by degrees as the new growth increases its leaves, and is thereby enabled to perform the full functions of a top. If there are many limbs below the bud, cut half of them when the top is cut, and remove the others at two or three cuttings between that time and the middle of June.

When not budded before the middle of July neither the top nor the branches of a stock should be cut till the following winter. As soon as the bud is well set, cut the string and let both scion and stock alone till time for winter pruning.

In case of patch-budding limbs of large trees instead of bark-grafting them, cutting back for the purpose of forcing out the buds should be done according to directions just given; but, in addition, care should be taken to cut out enough above the buds to give air and sunlight to the new growth.

Budding Knife (16): The best kind of knife for patch-budding is shown in Figure 14. The particular knife was made by the writer. Two cheap pocket knives with iron handles were purchased at a hardware store. The merchant drilled holes in the handles at the time of the purchase, first placing the knives together and arranging the blades parallel. The

knives werethen rivited to a block of wood, so the blades would stand exactly parallel and be an inch apart.



(Figure 14—Patch-Budding Knife).

Similar knives have been made by using ordinary kitchen knives and shoe knives with wooden handles. The handles can be easily trimmed flat and rivited to the block. The use of two set blades is that of a measure to effect a close fit of the bark of scion and stock at top and bottom—the sides are not so important. It will be recalled that the circulation of the prepared foods of a tree is from the leaves downward, principally, and this explains the necessity of an exact fit at top and bottom. It is really better to do the cutting with a single sharp blade, by drawing it across the bark rather than by direct pressure without sliding. Cutting with a dull knife, especially without sliding, tends to close the cells through which the elaborated foods pass.

In the absence of a double-bladed knife patch-budding can be done with some other measure like a lock staple with the two ends filed thin.

Transferring Buds (17): In the operation of patch-budding the bark of the stock should be cut first. The corners should be carefully cut so the section of bark will not hang when being removed. Loosen the section to make sure it is clear, but push it back in place quickly to protect the cells under it from exposure while the section is being cut from the scion in like manner. When the latter section has been cut and thoroughly loosened, flip out the section from the stock and make the transfer of the other quickly. It is well to have the string ready, as otherwise the bud may fall out while the string is being prepared.

RECIPE FOR BUDDING AND GRAFTING WAX.

Rosin two parts, beeswax one part.

Melt together and set off to cool, stirring occasionally.

Just before the mixture is cool enough to solidify, which can be told by its beginning to stick to the sides and bottom of the vessel, pour in alcohol slowly, stirring all the while. Continue to add alcohol till the whole mass has turned a golden yellow color, and has reached the consistency of soft mush. The quantity of alcohol necessary is about two-thirds the volume of the other combined materials.

Grain alcohol is preferable, wood alcohol will do, but denatured alcohol will not do.

PECAN SCIONS ON HICKORY STOCKS.

The methods of budding and grafting pecan scions to pecan stock, herein decribed, will apply to budding and grafting pecan scions to hickory stocks and also to English walnut scions to black walnut stocks, though the latter tree winter-kills so badly in Texas as to render the work useless.

The question is often asked, "Will it pay to use the hickory as a stock for the pecan?"

The pecan is a thrifty grower, and the writer is of the opinion that it will not pay to use pecan scions on dwarf hickories—the top will outgrow the stock—but there is little doubt that the pecan will do well on the larger and more thrifty-growing varieties of hickory.